FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-28311-2E

ASSP

1CHANNEL 10-BIT D/A CONVERTER

MB40760

■ DESCRIPTION

MB40760 is a low-power consumption, high-speed 10-bit D/A converter.

The MB40760 is characterized by TTL compatible digital inputs, an analog output voltage from 3 to 5V, and a maximum conversion rate of 60 MHz. It provides a reference voltage from a potential divider and band-gap reference, and can also use an external reference voltage.

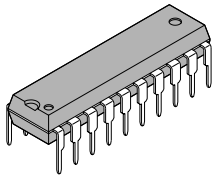
The MB40760 D/A converter is suitable for high-resolution TVs or VTRs.

■ FEATURES

- Resolution: 10 bits
- Conversion characteristics:
  Maximum conversion rate: 60 MHz (Minimum)
  Linearity error: ±0.1% (Maximum)
  Differential linearity error. ±0.1% (Maximum)
- Input and output:
  Digital input voltage: TTL levels
  Analog output voltage: 2 V_{P-P} (3V to 5V)
- Reference voltage
  V_{ROUT1}: Potential divider circuit (0.6 V_{CCA})
  V_{ROUT2}: Band-gap reference circuit (V_{CCA}-2V)
- Others
  Supply voltage: +5V single power supply
  Power dissipation: 180 mW (Typical value at analog output voltage 2 VP-P)
  140 mW (Typical value at analog output voltage 1 VP-P)

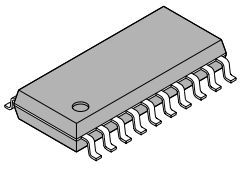
■ PACKAGES

Plastic DIP, 20 pin



(DIP-20P-M01)

Plastic SOP, 20 pin



(FPT-20P-M01)

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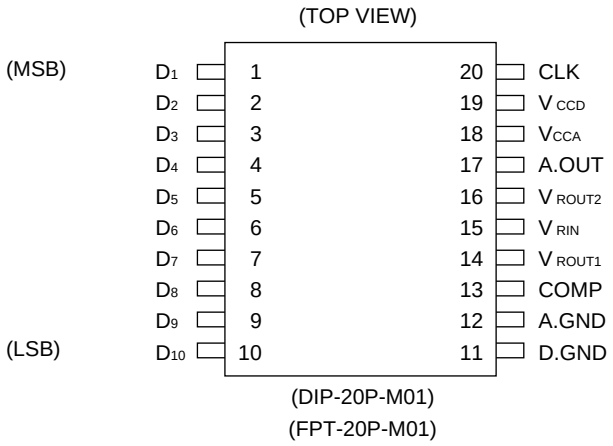
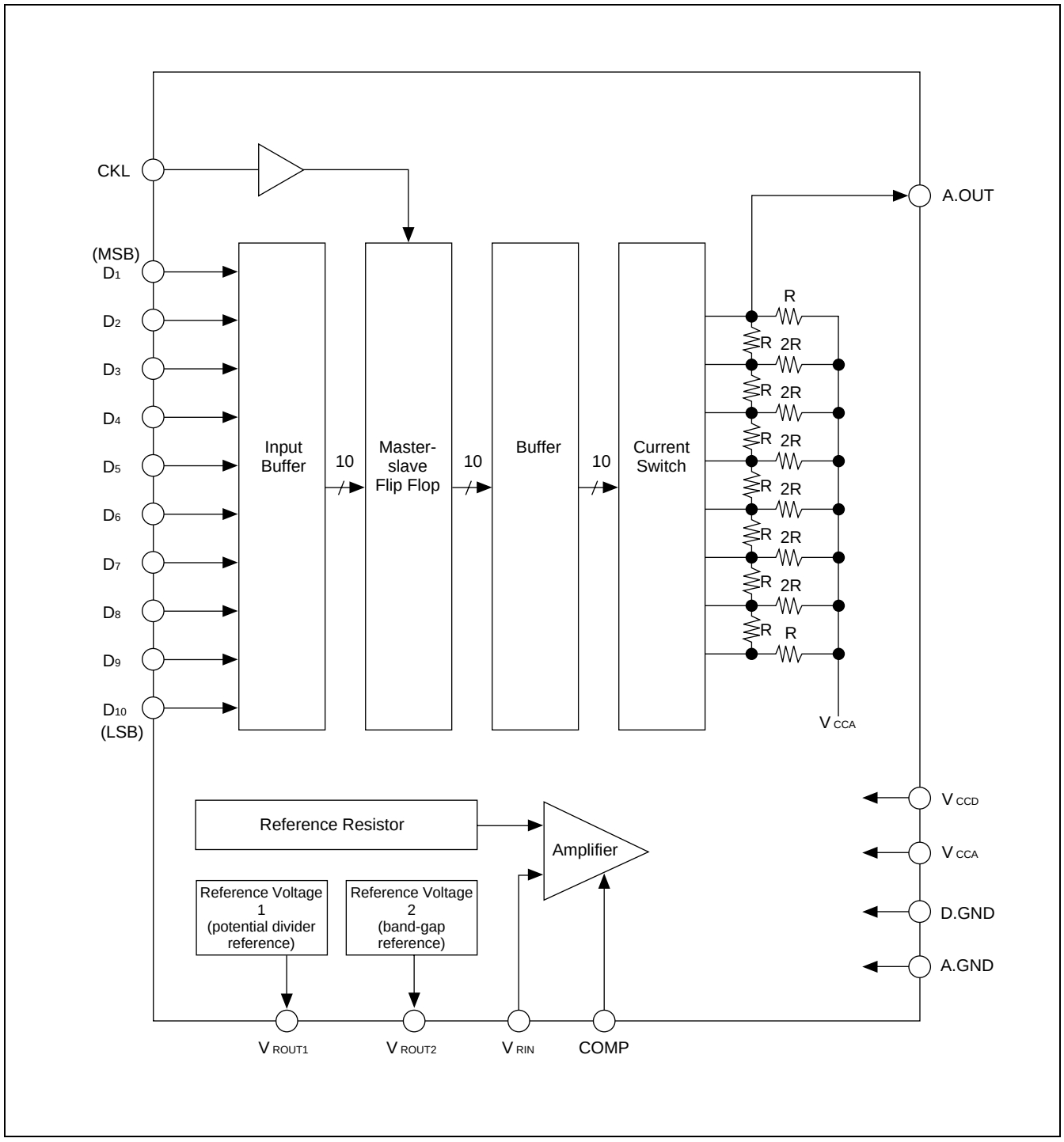
■ PIN ASSIGNMENT



■ PIN DESCRIPTIONS

Pin No.	Symbol	I/O	Description
1 to 10	D_1 to D_{10}	I	Data signal input pin (D_1: MSB, D_{10}: LSB)
20	CLK	I	Clock signal input pin
19	V_{CCD}	—	Digital power pin (+5V)
18	V_{CCA}	—	Analog power pin (+5 V)
11	D.GND	—	Digital ground pin (0V)
12	A.GND	—	Analog ground pin (0V)
15	V_{RIN}	I	Reference voltage input pin Analog output dynamic range setup pin Connect to pin 14 ot 16 to use the built-in reference voltage When using an external reference voltage, the voltage on this pin must be from 2.7V to 4.3V, and V_{CCA}-V_{RIN} must be from 0.7V to 2.2V
14	V_{ROUT1}	O	Reference voltage output pin 1 The output voltage of the potential divider reference is fixed at 0.6 V_{CCA}. When this pin is connected to pin 15, the analog output voltage ranges from 0.6 V_{CCA} to V_{CCA}
16	V_{ROUT2}	O	Reference voltage output pin 2 The output voltage of the band-gap reference is fixed at V_{CCA}-2.0(V). When the pin is connected to pin 15, the analog output voltage ranges from V_{CCA}-2.0(V) to V_{CCA}
13	COMP	—	Phase compensation capacitor pin Insert a capacitor of 0.1 µF or greater between A.GND and COMP for phase compensation
17	A.OUT	O	Analog signal output pin

■ BLOCK DIAGRAM



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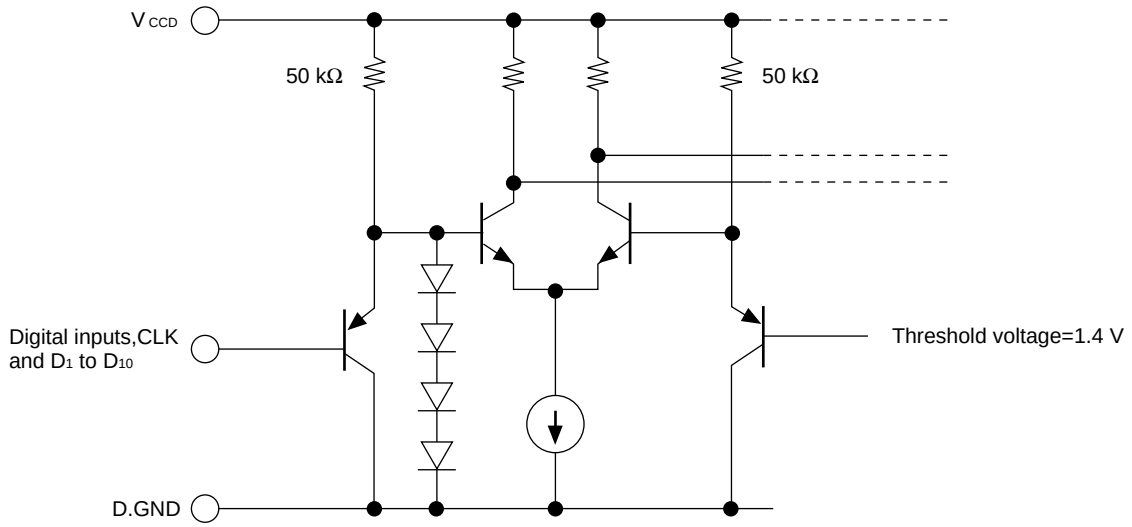
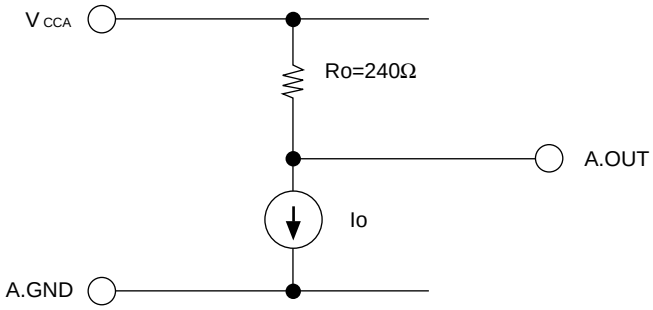
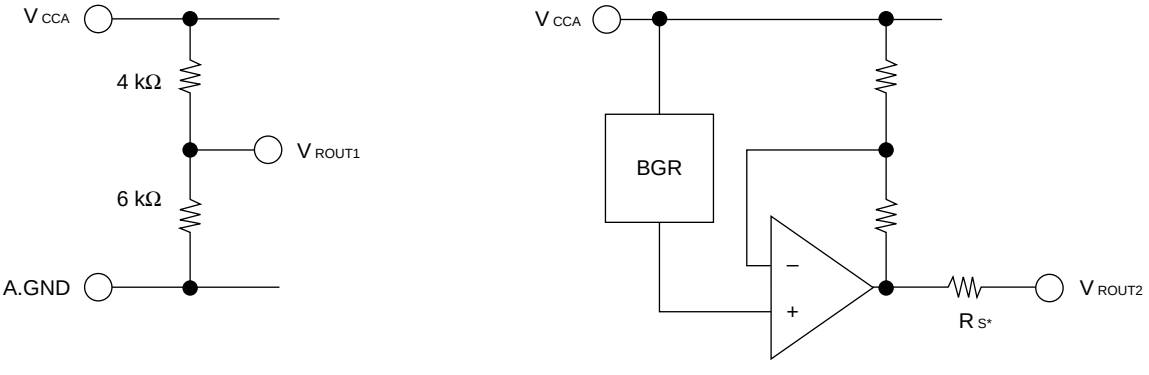
■ DIGITAL INPUT EQUIVALENT CIRCUIT



■ ANALOG OUTPUT EQUIVALENT CIRCUIT

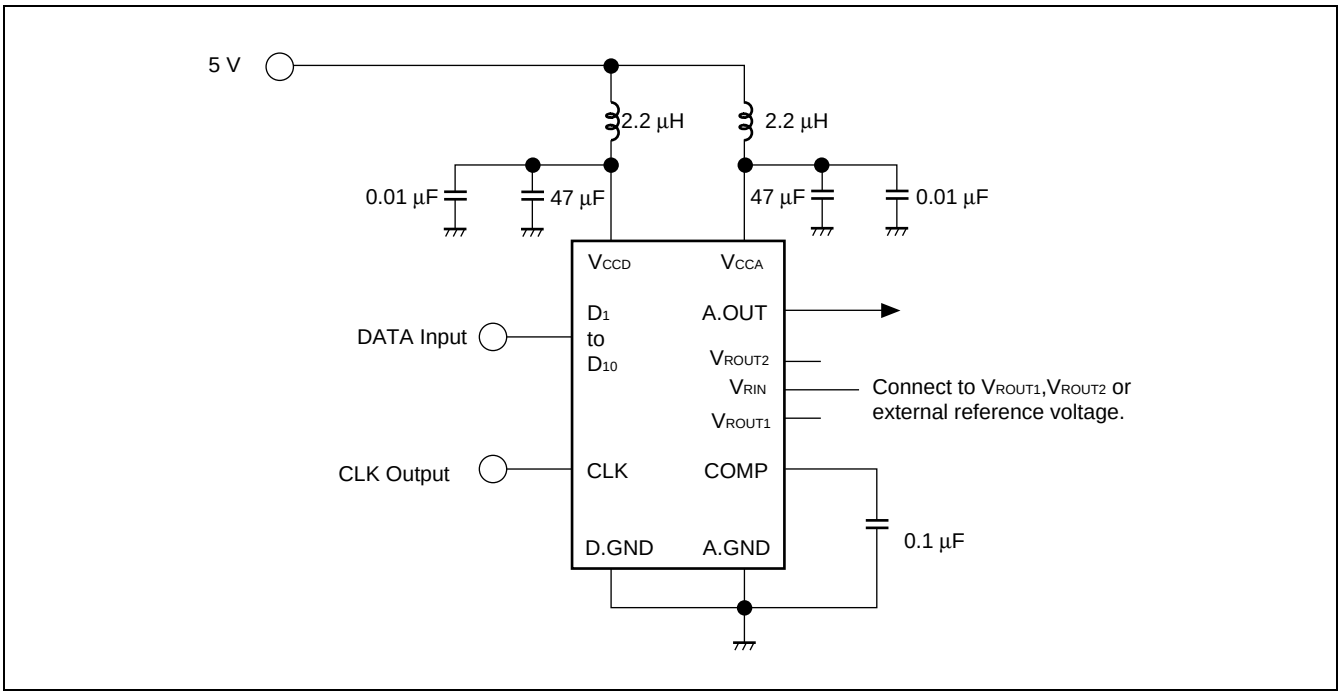


■ REFERENCE VOLTAGE OUTPUT EQUIVALENT CIRCUIT



*:Overcurrent -prevention resistor (2 kΩ)for a short to GND.

■ TYPICAL CONNECTION EXAMPLE



■ ABSOLUTE MAXIMUM RATINGS

(A.GND = D.GND = 0V, Ta = +25°C)

Parameter	Symbol	Value	Unit
Analog power supply voltage	V_{CCA}	–0.5 to +7.0	V
Digital power supply voltage	V_{CCD}	–0.5 to +7.0	V
Power supply voltage difference	V_{CCD}–V_{CCA}	1.5	V
Digital signal input voltage	V_{ID}	–0.5 to +7.0	V
Storage Temperature	Tstg	–55 to +125	°C

Note: Permanent device damage may occur if the above Absolute Maximum Rating are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

■ RECOMMENDED OPERATING CONDITIONS

(A.GND = D.GND = 0V, Ta = –20°C to +75°C)

Parameter		Symbol	Standard values			Unit
			Min.	Typ.	Max.	
Power supply voltage	Analog power supply voltage	V_{CCA}	4.75	5.00	5.25	V
	Digital power supply voltage	V_{CCD}	4.75	5.00	5.25	V
	Power supply voltage difference	V_{CCA}-V_{CCD}	–0.2	—	0.2	V
Analog reference voltage		V_{CCA}-V_{RIN}	0.70	2.00	2.20	V
		V_{RIN}	2.65	3.00	4.30	V
Digital input high voltage		V_{IHD}	2.0	—	—	V
Digital input low voltage		V_{ILD}	—	—	0.8	V
Clock frequency		f_{CLK}	—	—	60	MHz
Setup time		tsu	8	—	—	ns
Hold time		th	2	—	—	ns
Clock minimum pulse width high		t_{WH}	6.5	—	—	ns
Clock minimum pulse width low		t_{WL}	6.5	—	—	ns
Phase compensation capacitor		C_{COMP}	0.1	—	—	µF
Operating temperature		T_{OP}	–20	—	75	°C

■ DC CHARACTERISTICS

(V_{CCA} = V_{CCD} = 4.75 to 5.25V, A.GND = D.GND = 0V, Ta = –20°C to +75°C)

Parameter		Symbol	Conditions	Standard values			Unit
				Min.	Typ.	Max.	
Resolution		—	—	—	—	10	bit
Linearity error		LE	DC accuracy	—	—	±0.1	%
Differential linearity error		DLE		—	—	±0.1	%
Digital input current high		I_{IHD}	V_{IHD} = 2.7V	—	—	20	µA
Digital input current low		I_{ILD}	V_{ILD} = 0.4V	–100	—	—	µA
Reference input current		I_{RIN}	V_{RIN} = 3.000V	—	—	10	µA
Potential divider reference	Reference voltage	V_{ROUT1}	V_{CCA} = 5.00V V_{CCD} = 5.00V	2.900	3.000	3.100	V
Band-gap reference	Reference voltage	V_{ROUT2}	—	V_{CCA} –2.100	V_{CCA} –2.000	V_{CCA} –1.900	V
	Temperature coefficient	—	—	—	100	—	ppm/°C
Full-scale output voltage		V_{OFS}	—	V_{CCA} –20	V_{CCA}	—	mV
Zero-scale output voltage		V_{OZS}	V_{CCA} = 5.00V V_{CCD} = 5.0V V_{RIN} = 3.000V	2.932	3.002	3.072	V
Output resistance		R_O	Ta = +25°C	192	240	288	Ω
Power dissipation		I_{CC}	V_{CCA} = 5.25V V_{CCD} = 5.25V V_{RIN} = V_{ROUT1}	—	36*	62	mA

* : V_{CCA} = V_{CCD} = 5V

■ AC CHARACTERISTICS

(V_{CCA} = V_{CCD} = 4.75 to 5.25V, A.GND = D.GND = 0V, Ta = –20°C to +75°C)

Parameter	Symbol	Conditions	Standard values			Unit
			Min.	Typ.	Max.	
Maximum conversion rate	F_S	C_L = 15pF A.OUT pin terminating resistance = 240Ω	60	—	—	MSPS
Output propagation delay time	tpd		—	7	—	ns
Output rise time	tr		—	5	—	ns
Output fall time	tf		—	5	—	ns
Settling time	tset		—	17.5	—	ns

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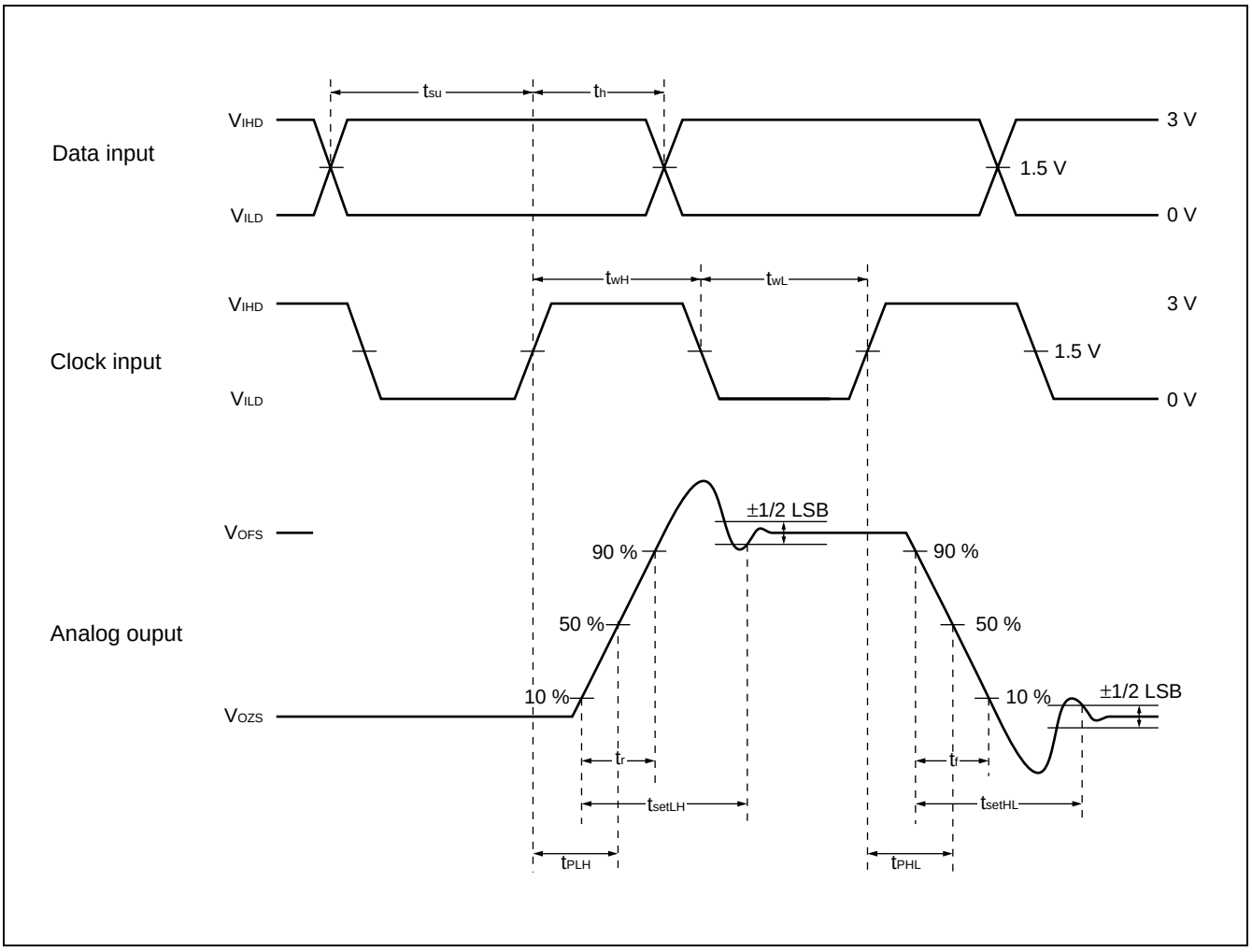
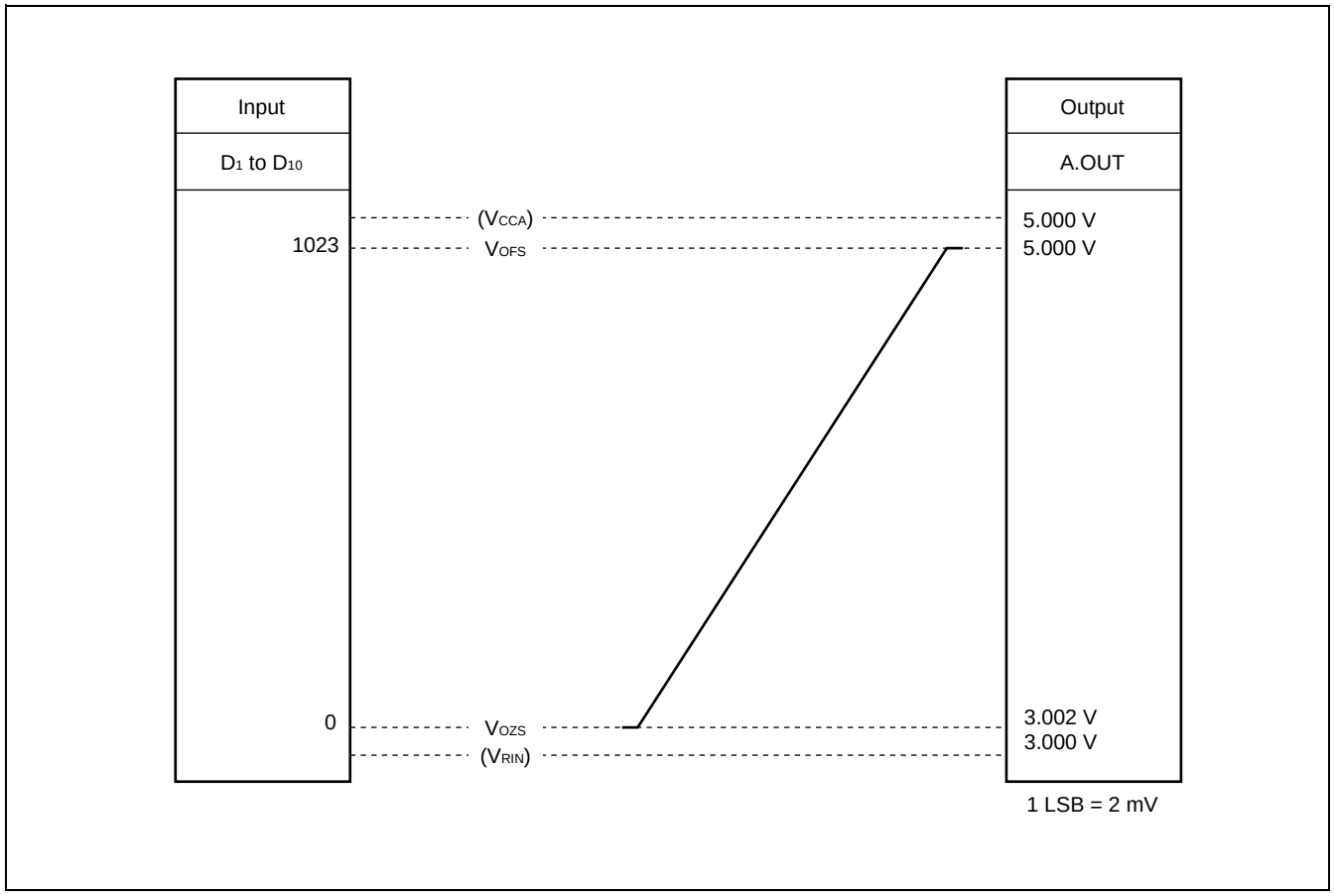
■ TIMING CHART



■ DAC OUTPUT VOLTAGE CHARACTERISTICS



■ DAC OUTPUT VOLTAGE FORMULA IN IDEAL CONDITIONS

$$A.OUT = V_{CCA} - \frac{1023 - N}{1024} \quad (V_{CCA} - V_{RIN})$$

(N: Digital input from 0 to 1023)

$$V_{OFS} = V_{CCA}$$

$$V_{OZS} = V_{CCA} - \frac{1023}{1024} \quad (V_{CCA} - V_{RIN})$$

Notes:

1. Preventing Switching Noise
   To prevent switching noise in the analog output signal, connect noise limiting capacitors to the VCCA and VCCD pins as close to the A.GND and D.GND pins as possible.
2. Power Pattern
   To reduce parasitic impedance, the PC board pattem to the VCCA, VCCD, A.GND and D.GND pins should be as wide as possible.

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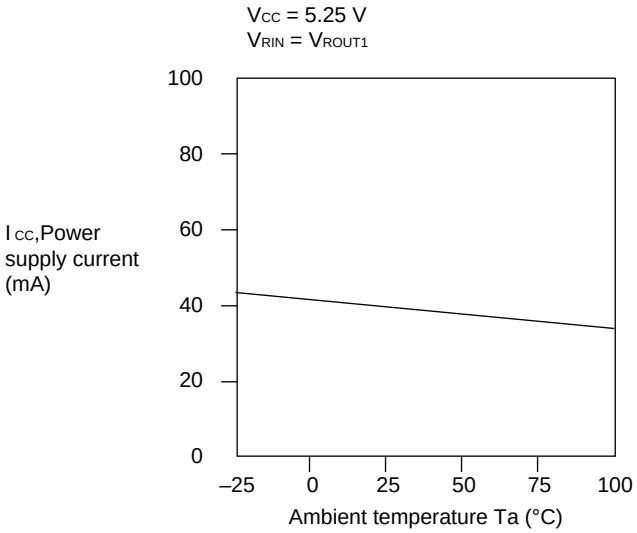
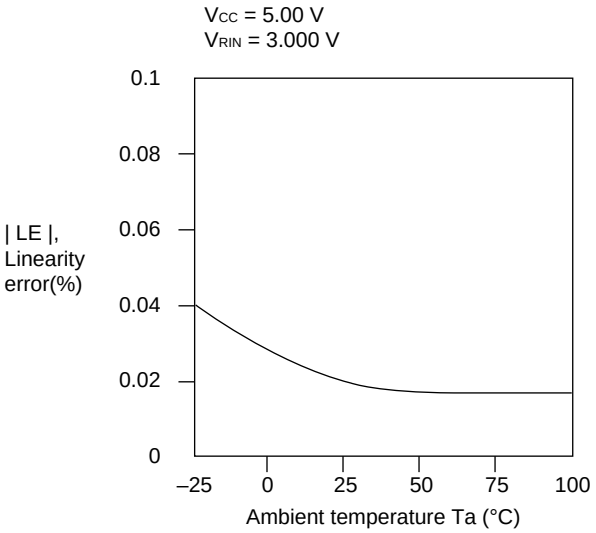
■ TYPICAL CHARACTERISTICS CURVES

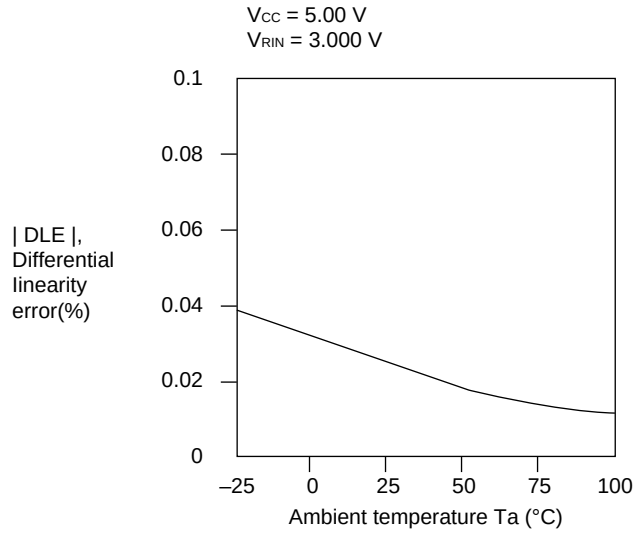
1.Power Supply Current v.s. Ambient Temperature



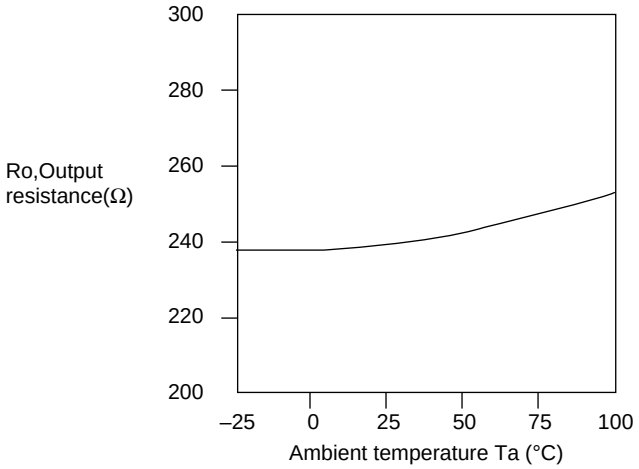
2.Linearity Error v.s. Ambient Temperature



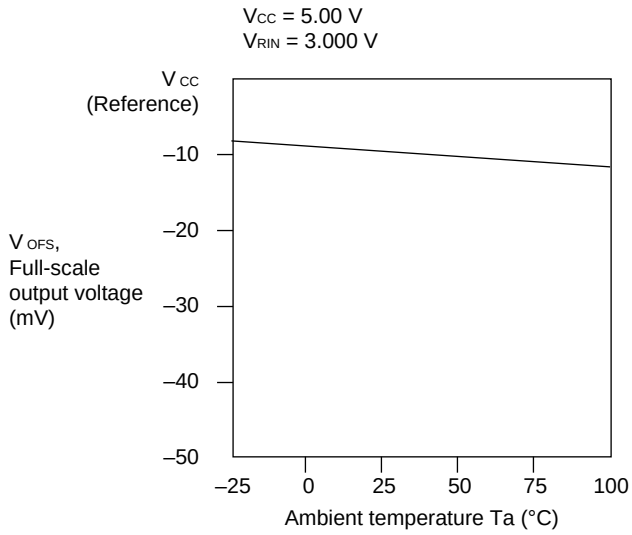
3.Differential Linearity Error v.s. Ambient Temperature



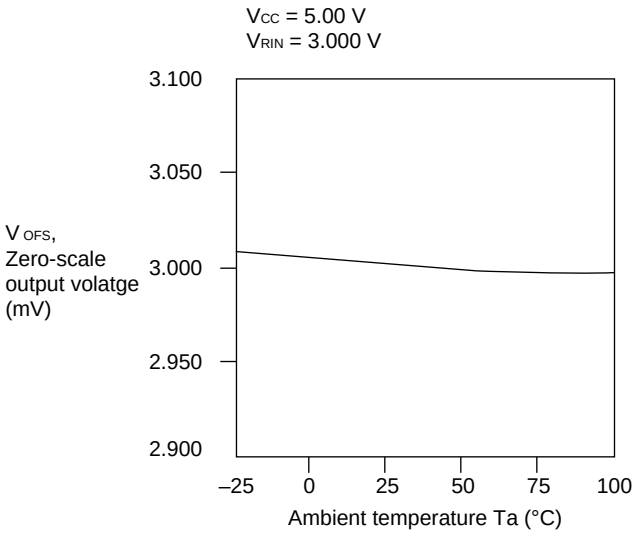
4.Output Resistance v.s. Ambient Temperature



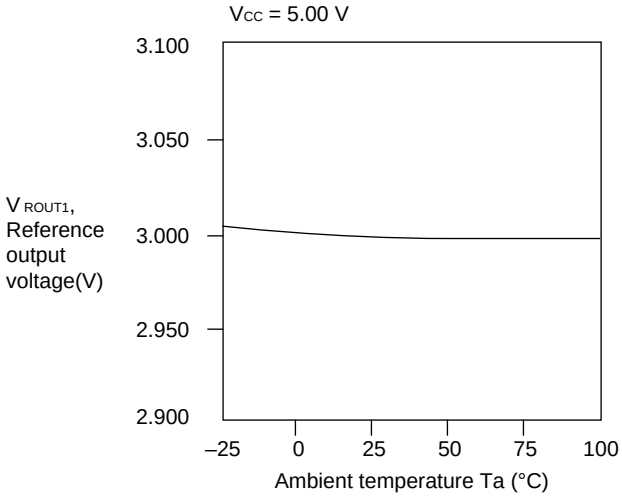
5.Full-Scale Output Voltage v.s. Ambient Temperature



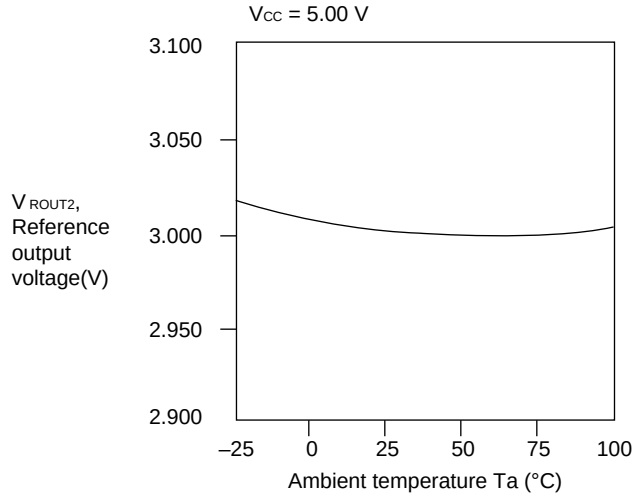
6.Zero-Scale Output Voltage v.s. Ambient Temperature



7.V ROUT1 Reference Output Voltage v.s. Ambient Temperature



8.V ROUT2 Reference Output Voltage v.s. Ambient Temperature



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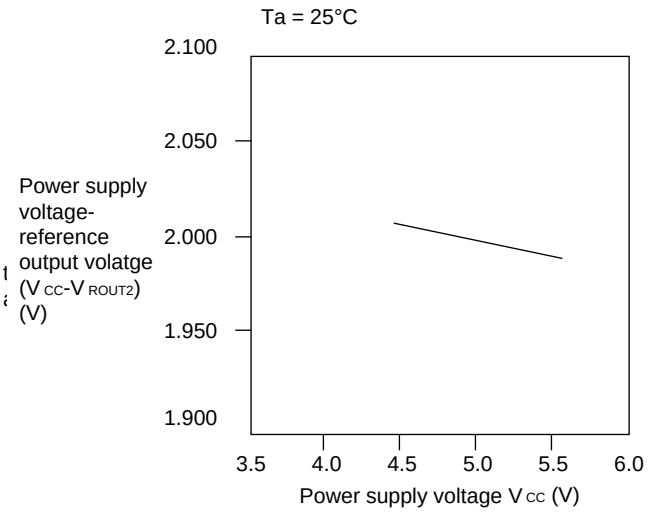
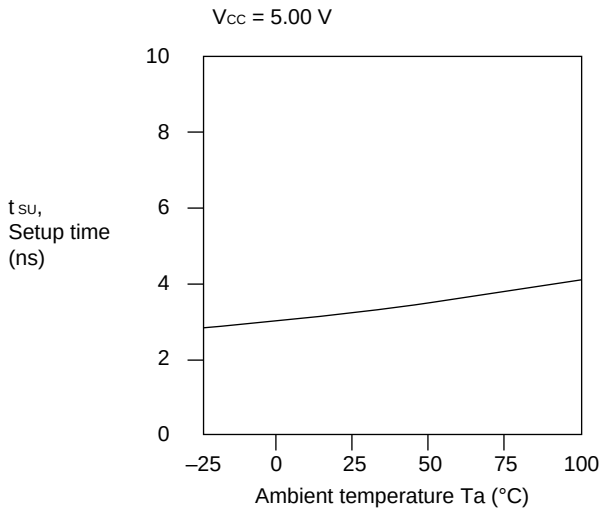
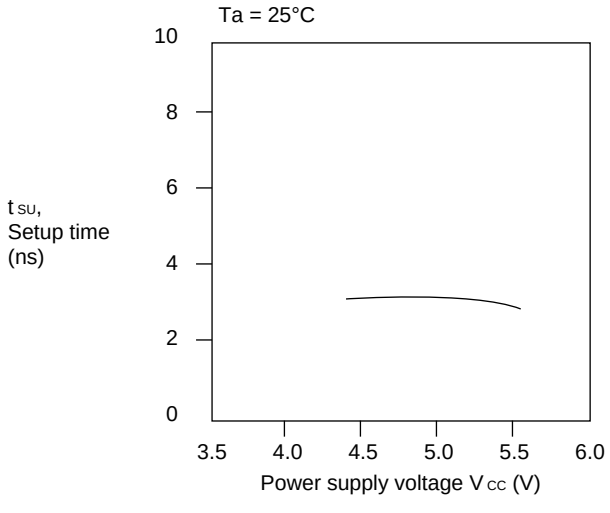
9.V_{ROUT2} Reference Output Voltage v.s. Power Supply Voltage



10.Setup Time v.s. Ambient Temperature

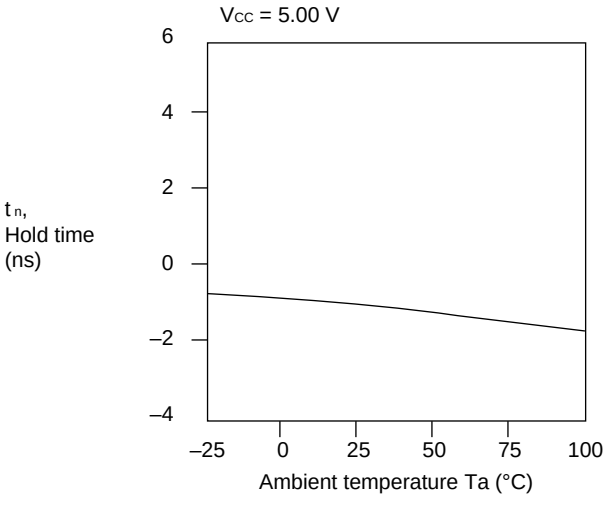


11.Setup Time v.s. Power Supply Voltage



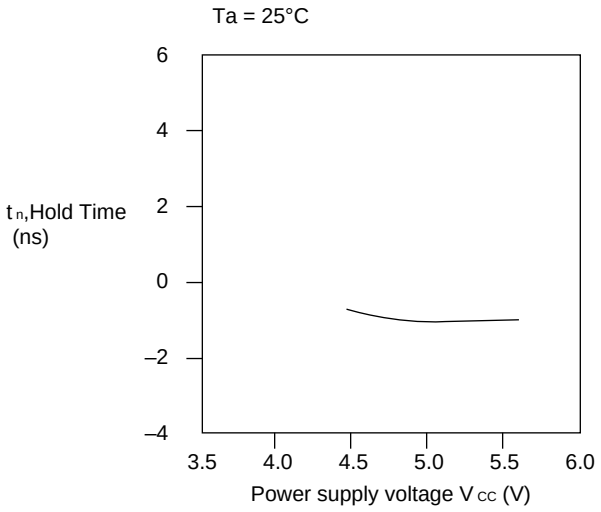
Power supply voltage V_{CC} (V)

12.Hold Time v.s. Ambient Temperature

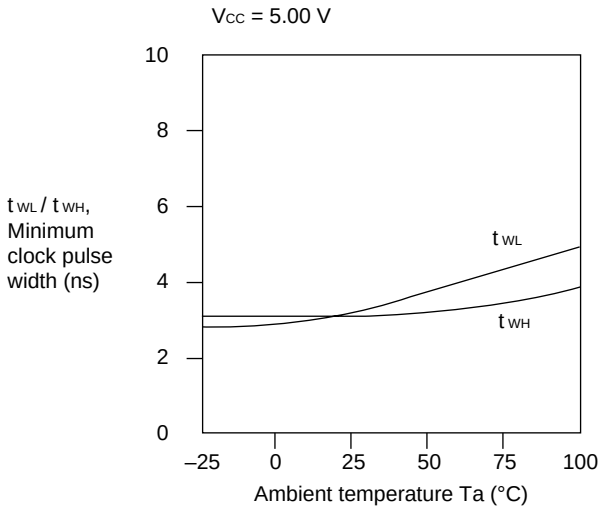


Analog output frequency f_{OUT} (MHz)

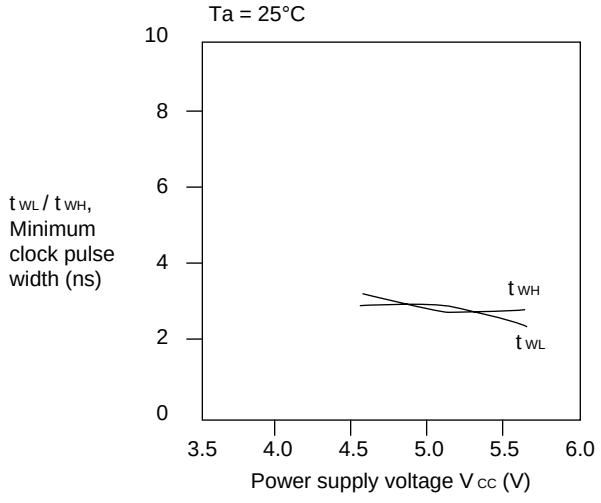
13.Hold Time v.s. Power Supply Voltage



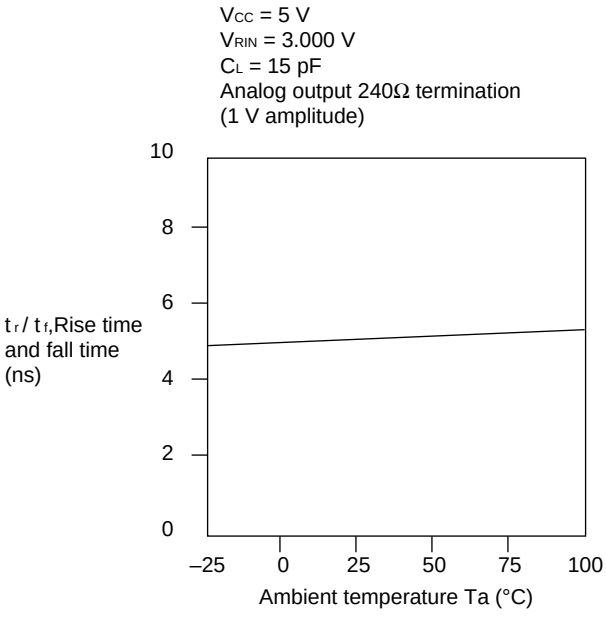
14.Minimum Clock Pulse Width v.s. Ambient Temperature



15.Minimum Clock Pulse Width v.s. Power Supply Voltage



16.Rise Time / Fall Time v.s. Ambient Temperature



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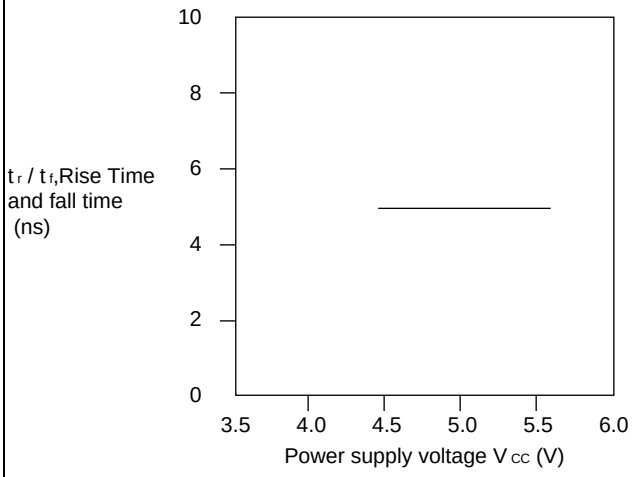
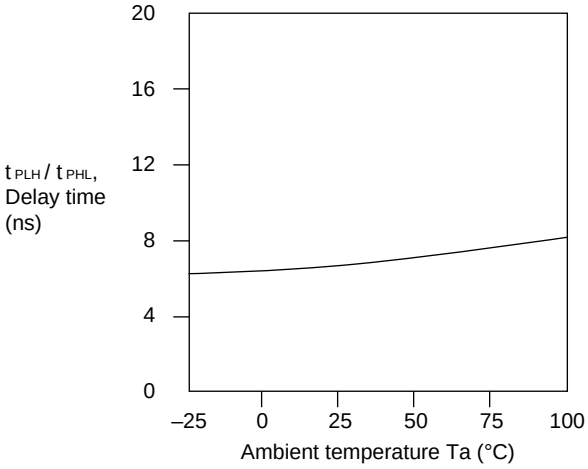
17.Rise Time / Fall Time v.s. Power Supply Voltage

Ta = 25°C
V_{RIN} = 3.000 V
C_L = 15 pF
Analog output 240Ω termination
(1 V amplitude)



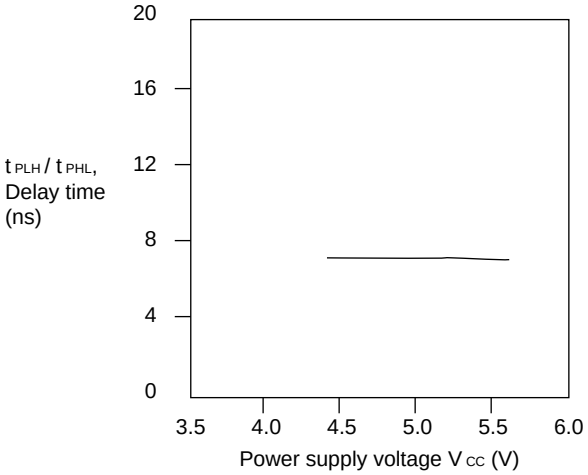
18.Delay Time v.s. Ambient Temperature

V_{CC} = 5.00 V
V_{RIN} = 3.000 V
C_L = 15 pF
Analog output 240Ω termination
(1 V amplitude)

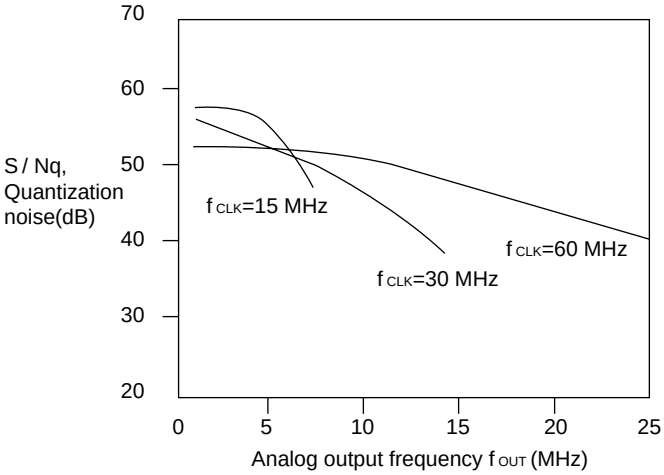


19.Delay Time v.s. Power Supply Voltage

Ta = 25°C
V_{RIN} = 3.000 V
C_L = 15 pF
Analog output 240Ω termination
(1 V amplitude)

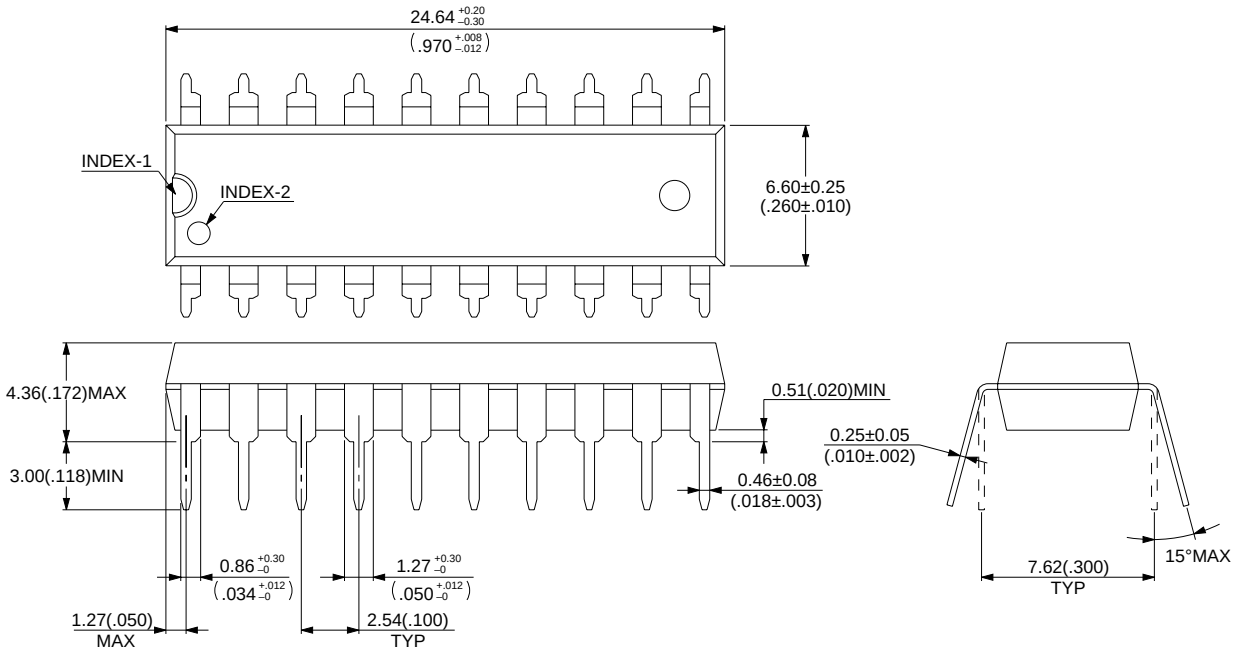


20.Quantization Noise v.s. Analog Output Frequency



■ PACKAGE DIMENSIONS

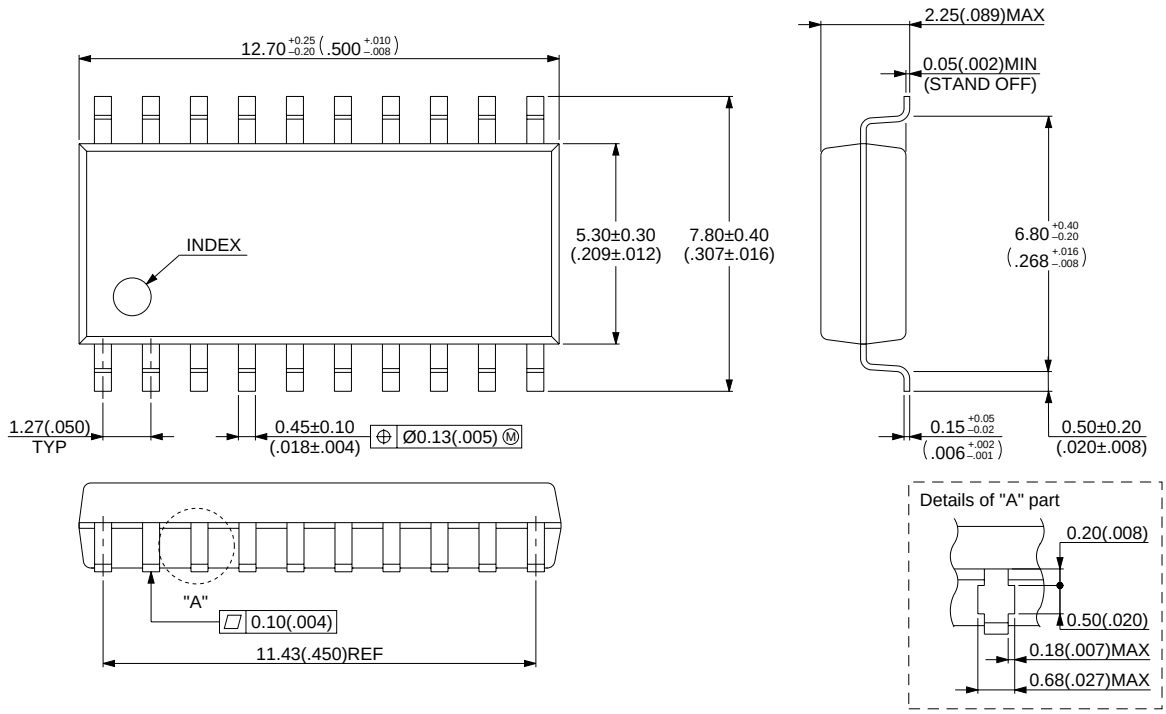
Plastic DIP, 20 pin
(DIP-20P-M01)



Dimensions in mm (inch)

MB40760

Plastic SOP, 20 pin
(FPT-20P-M01)



Dimensions in mm (inch)

MB40760

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